RICH Digitization & Reconstruction

Fermilab Meeting, Nov 2002

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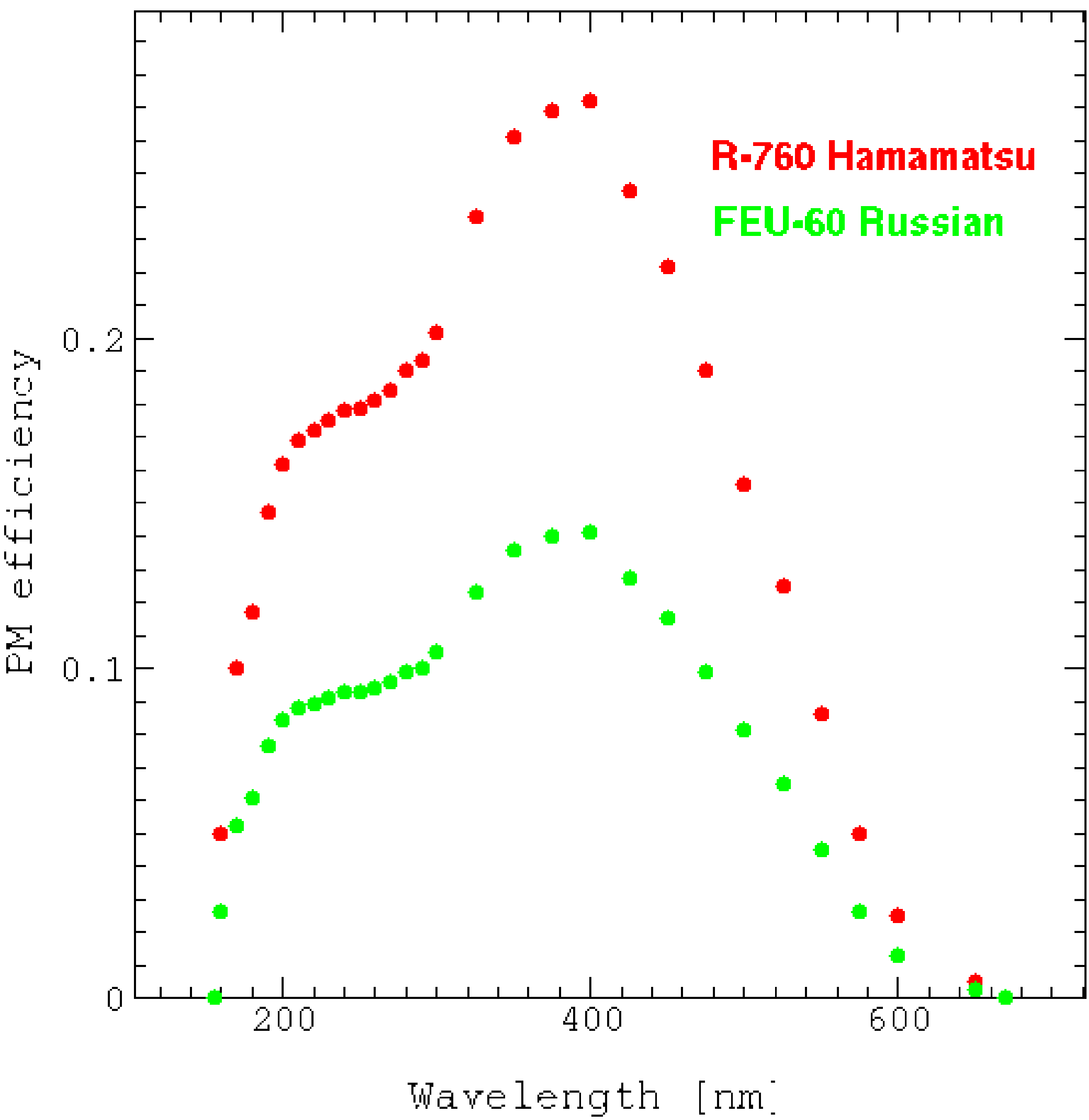
- Digitization Code
- Noise to Digits Study
- Ring Radii Study
- Reconstruction Algorithms
- Next Step

Digitization

- Code: completed
  - Poisson distribution of noise
  - PMT efficiency (SELEX code)
- Digitization value stored: PMT number
- Need to do a precise calculation on the expected number of photons

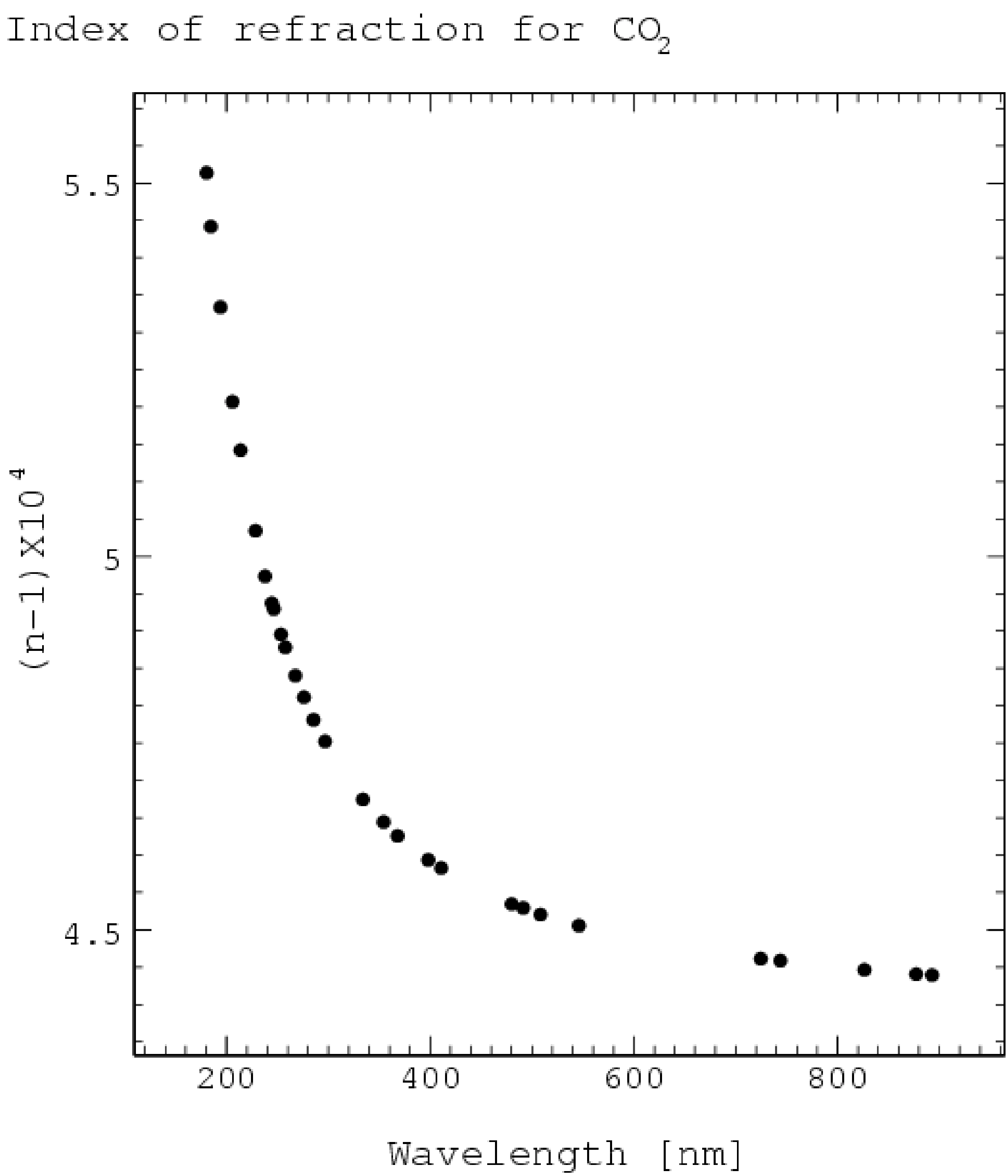
Digitization

Function of PM efficiency



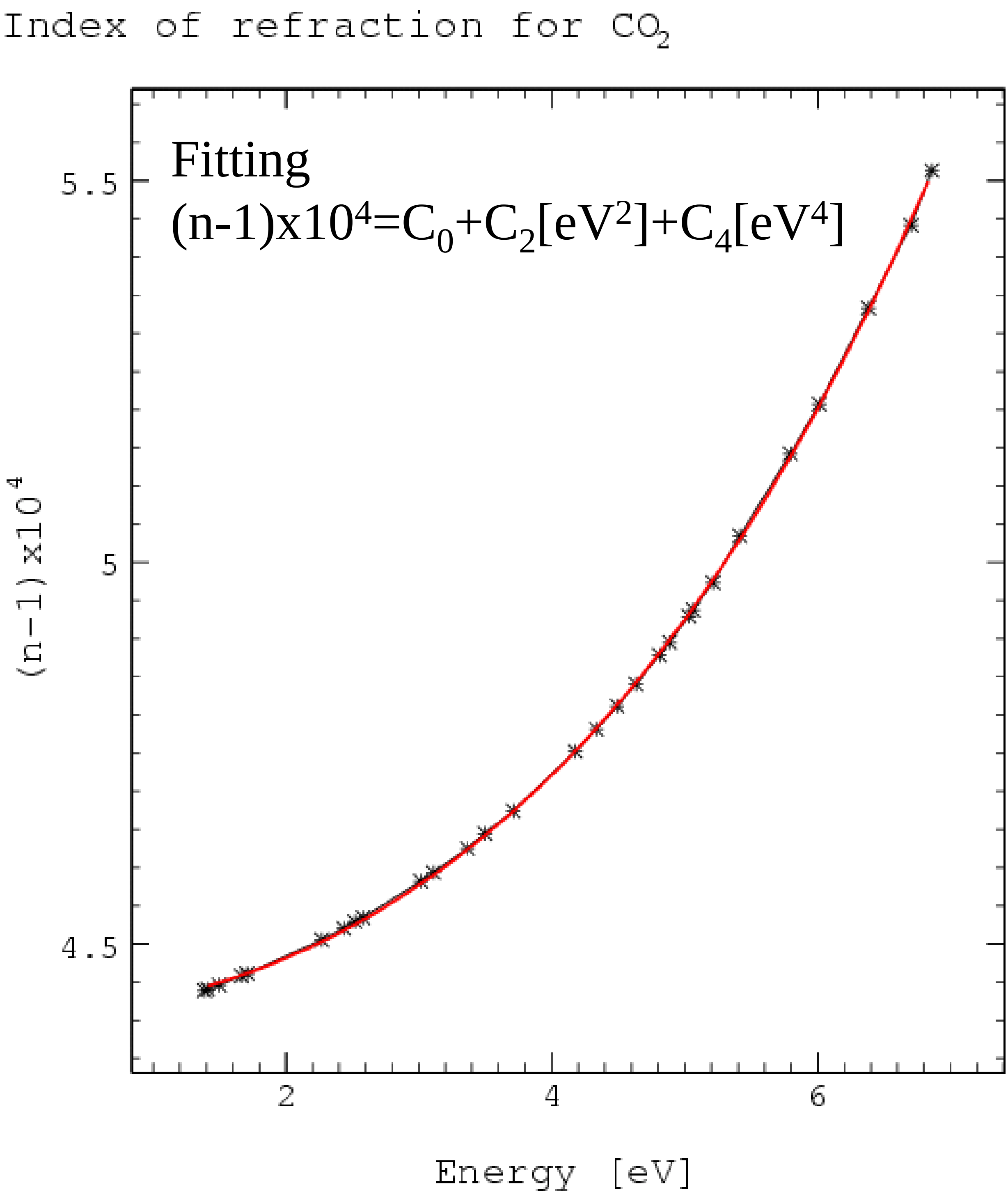
Source: SELEX code

Digitization

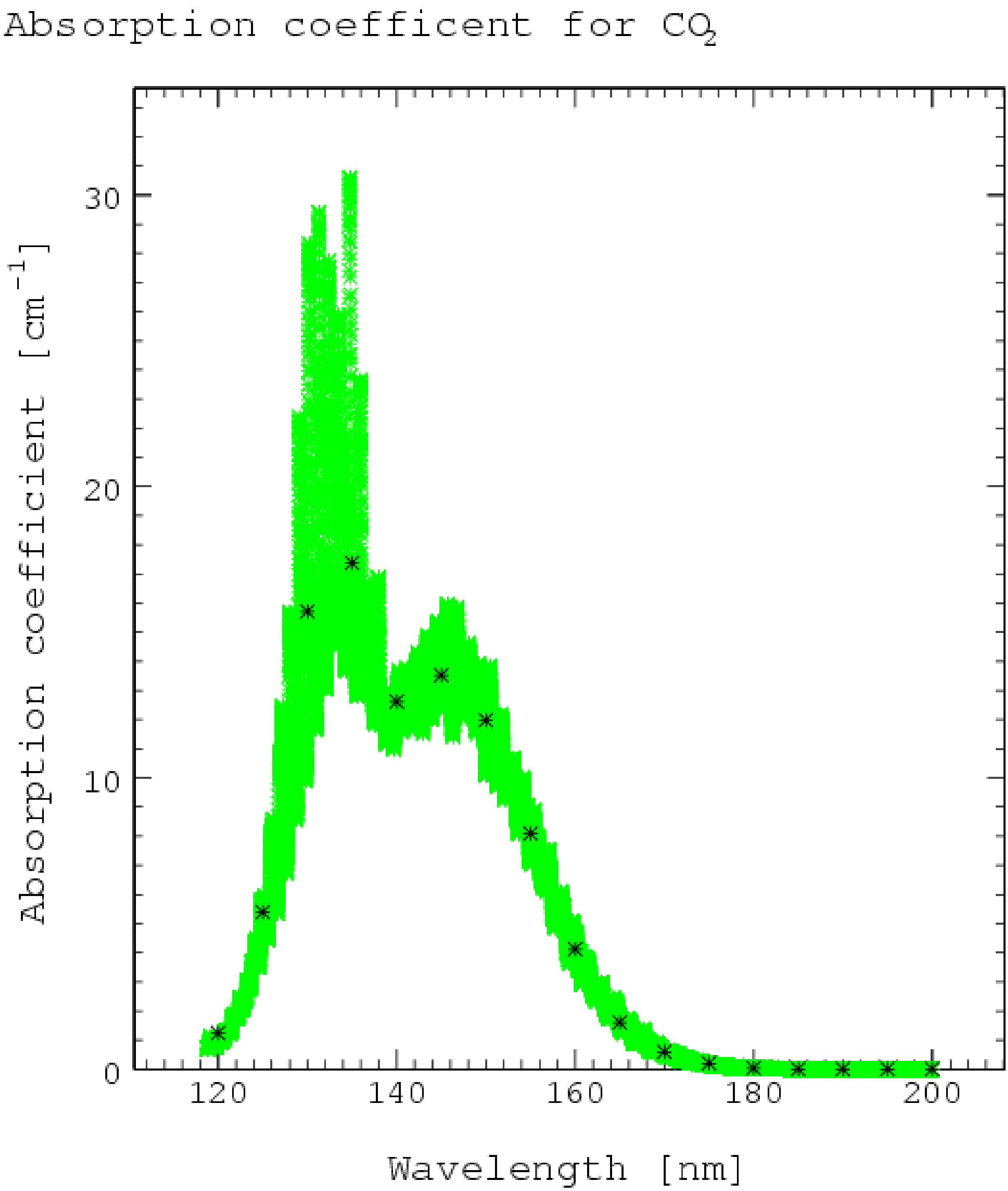


Source: library book

Digitization

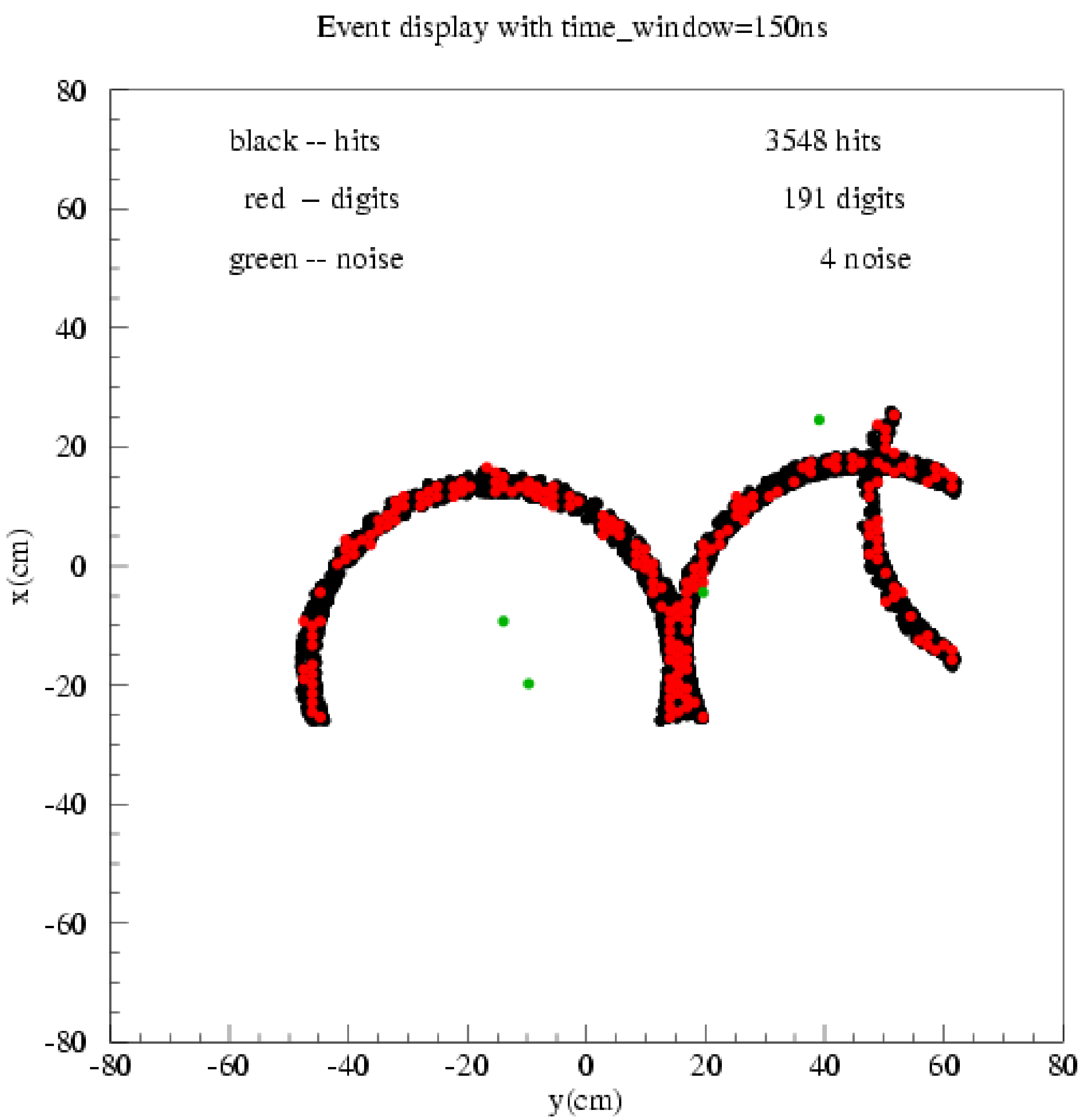


Digitization



Source: K. Yoshino, Harvard U

Noise to Digits Study



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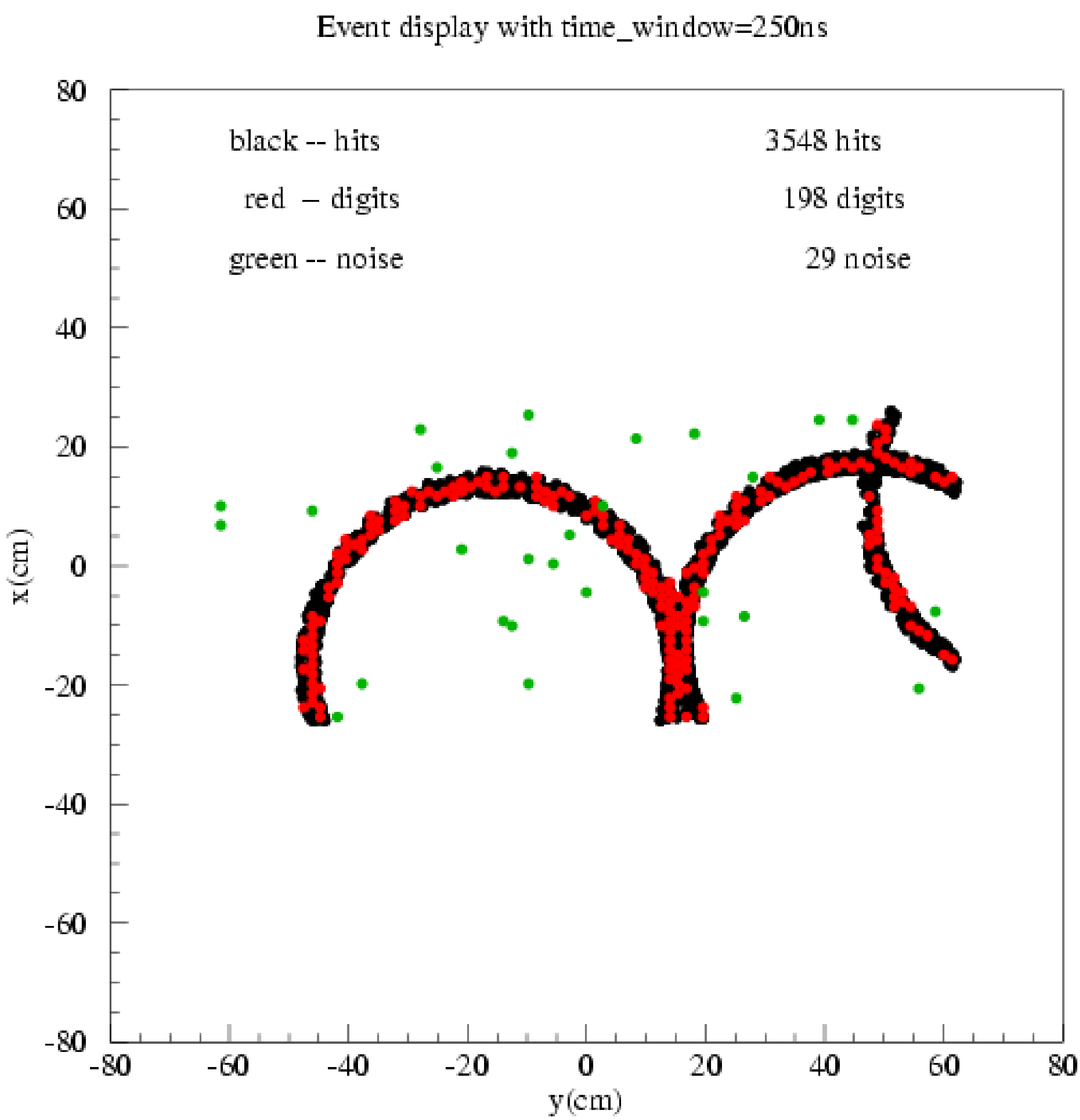

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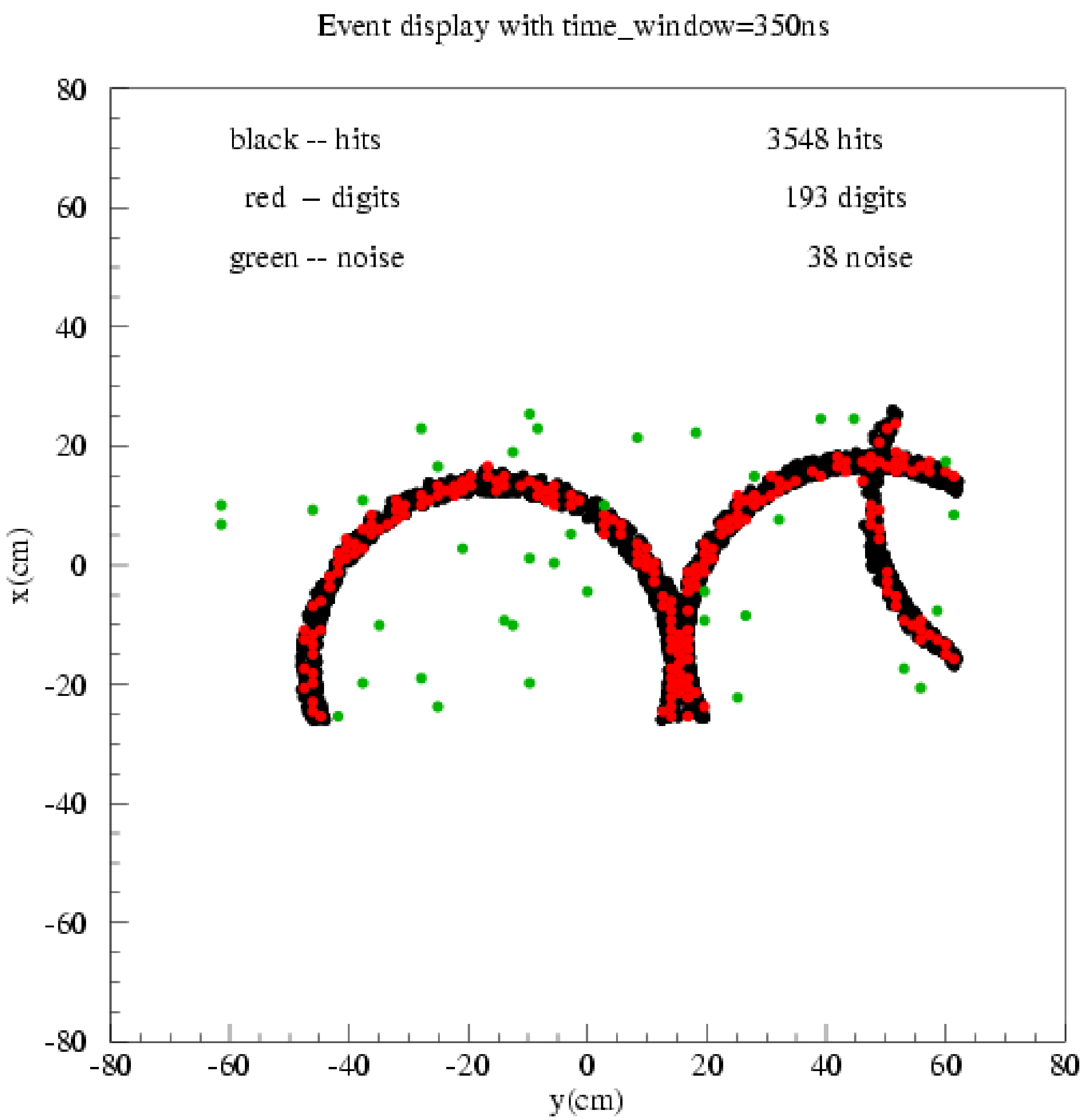

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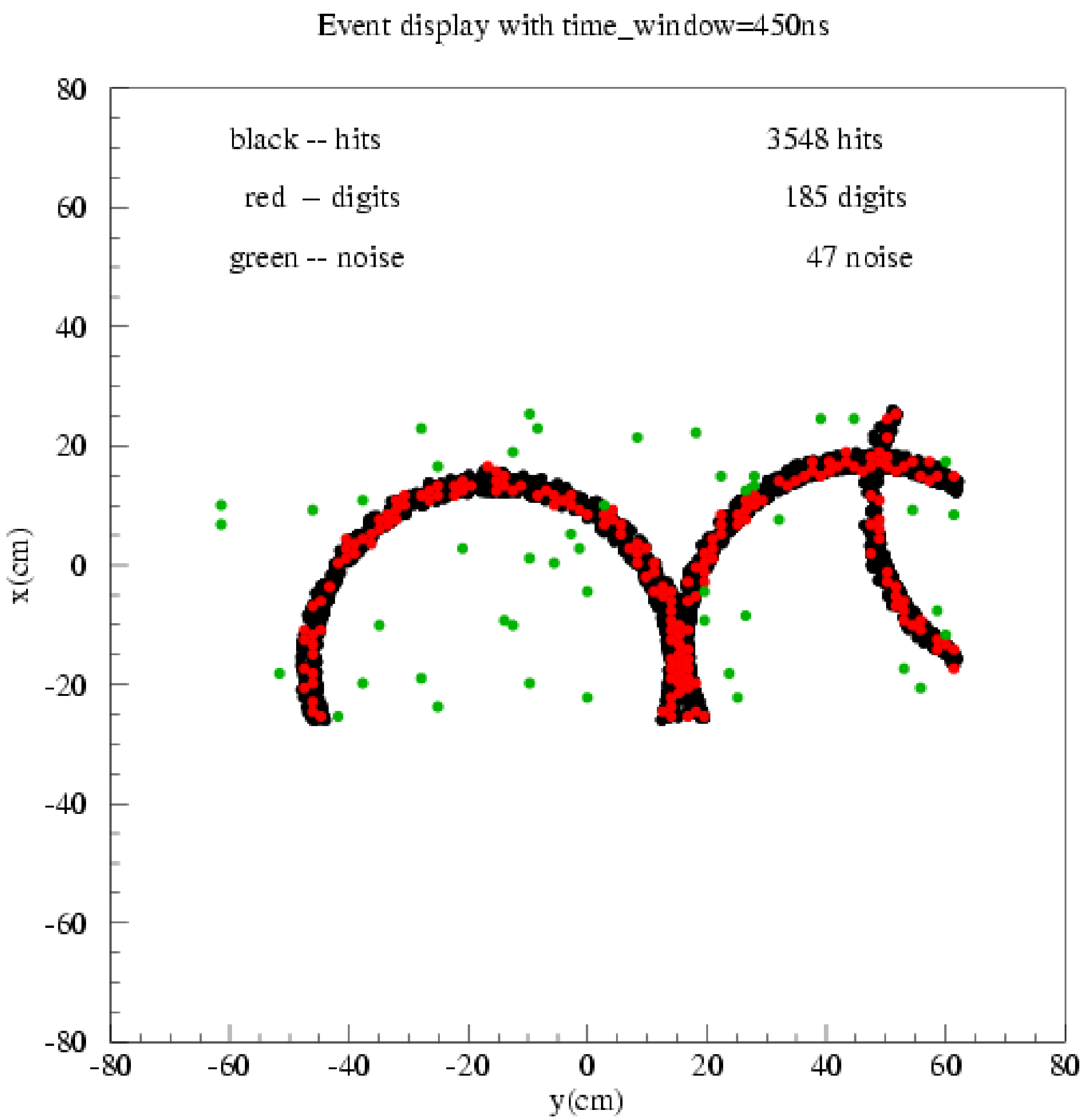
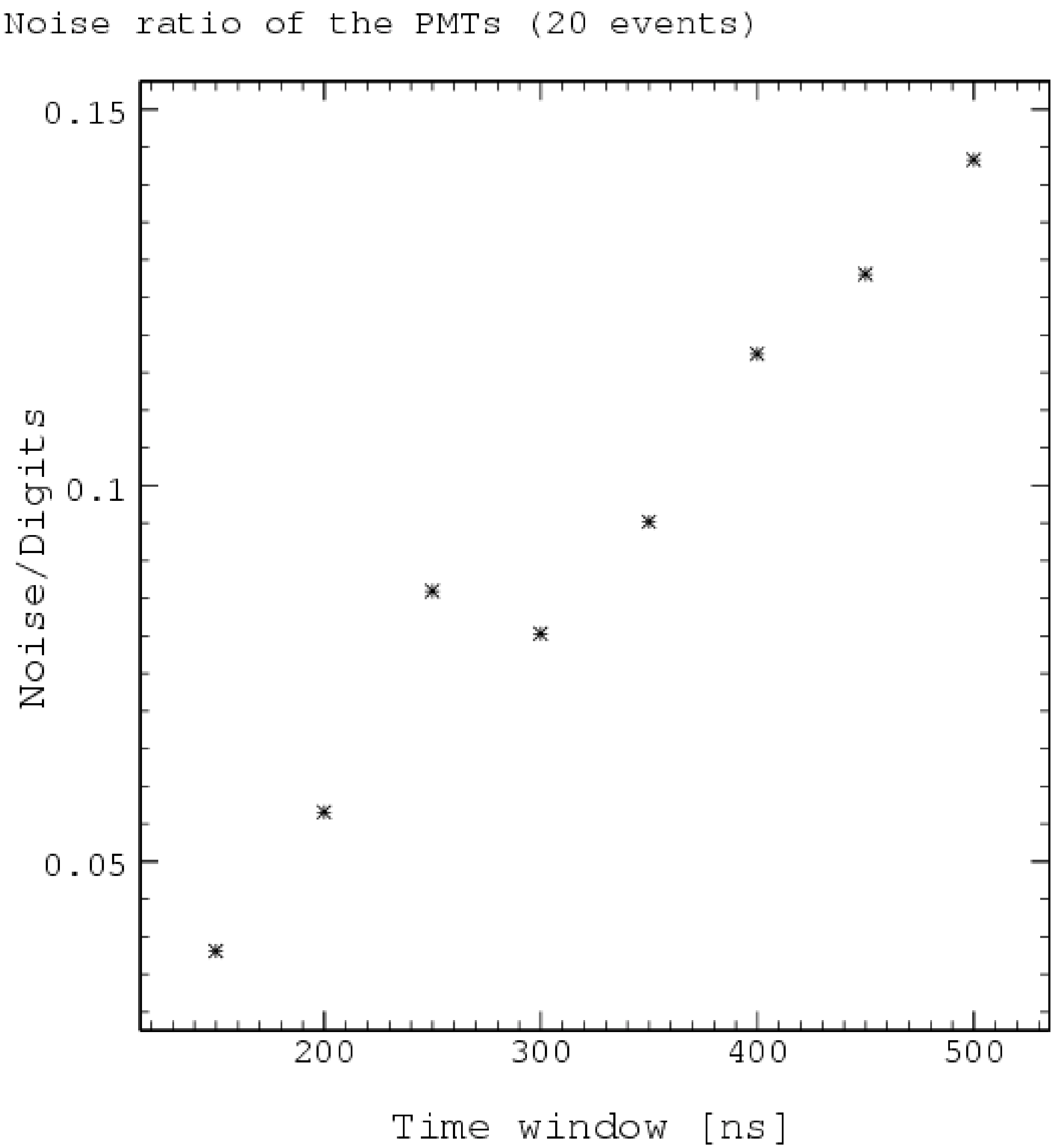


Noise to Digits Study



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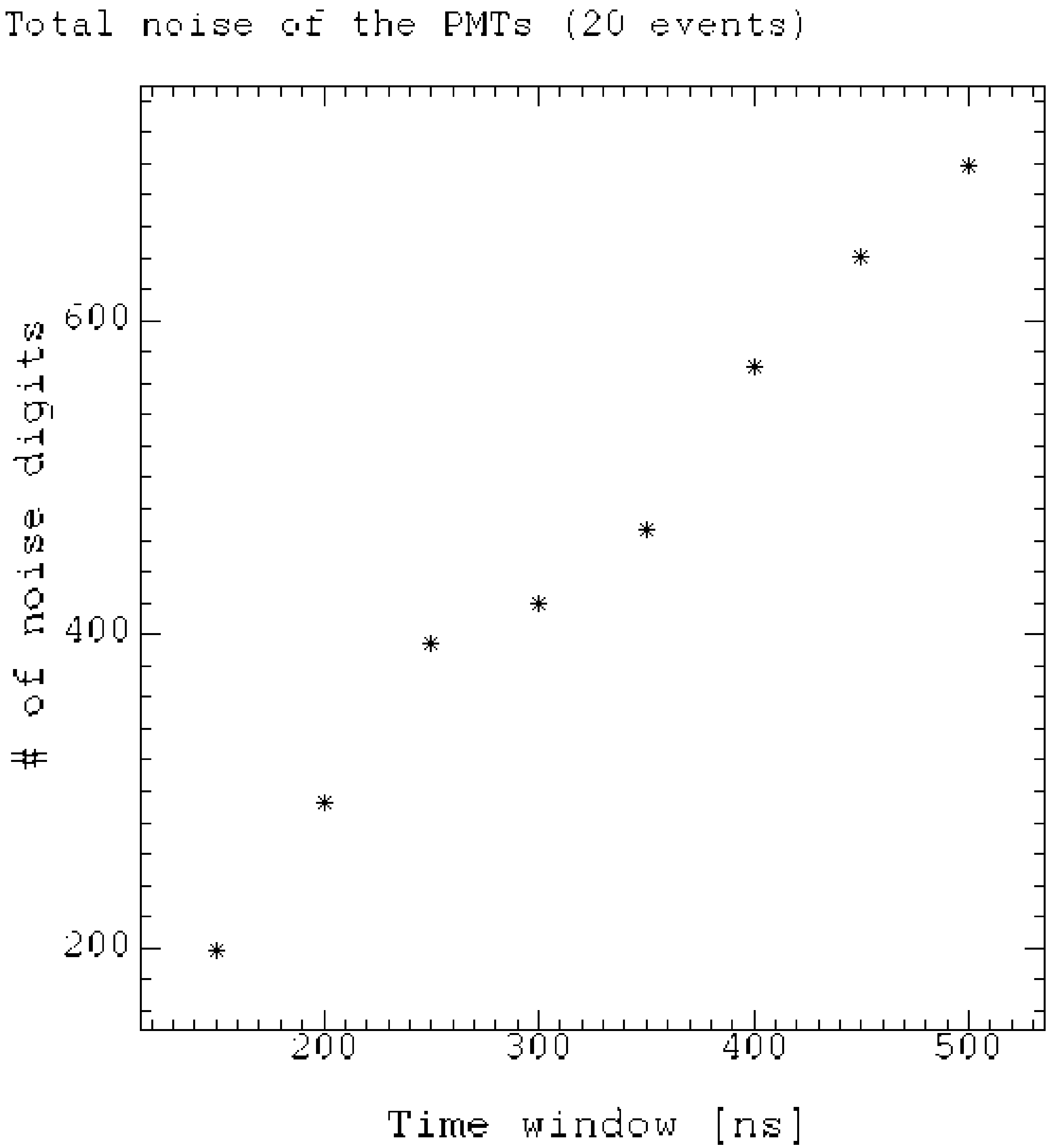
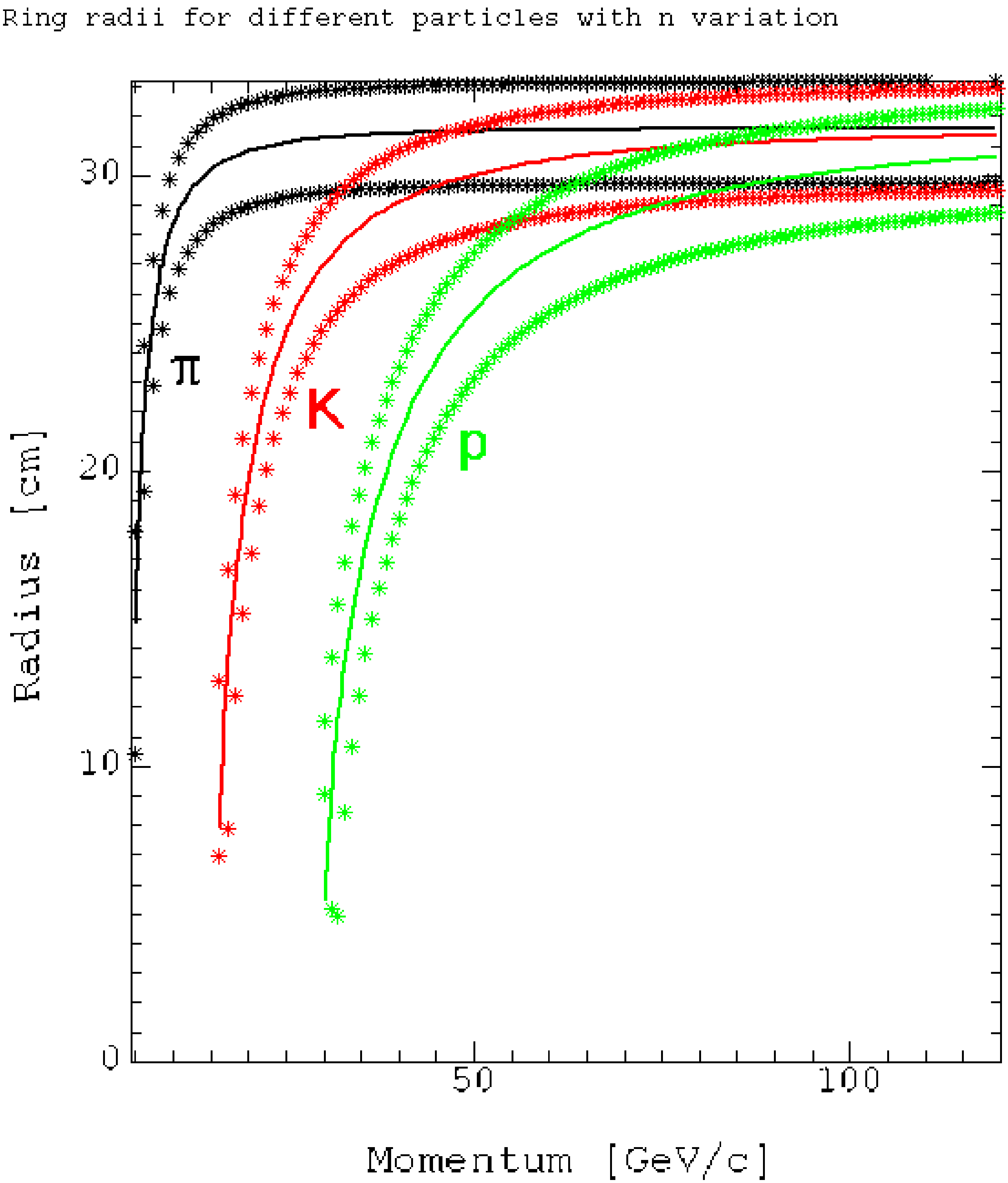
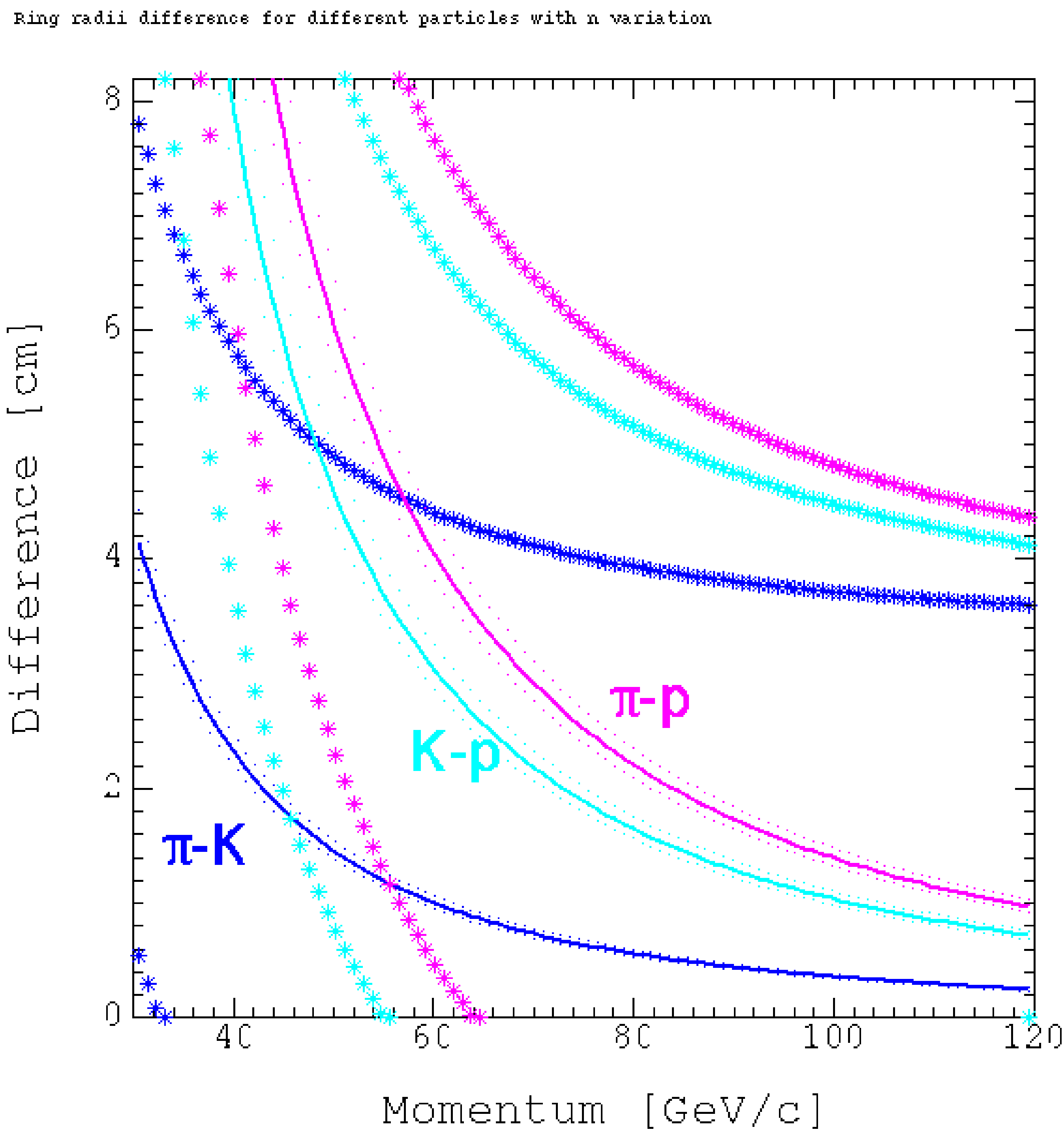


Ring Radii Study



Ring Radii Study



Reconstruction Algorithms

- For single ring, one can

$$\chi^2 = \frac{\sum_i \left(\sqrt{(x_i - x_0)^2 + (y_i - y_0)^2} - r_0 \right)^2}{\sigma^2}$$

- WA89: maximum likelihood method
  - Given momentum and ring center $\rightarrow$ predict rings radii for mass hypotheses π, K and p
  - Gaussian distribution for the signal

$$S_j(\vec{x}^{(i)}) = \frac{n_j}{2\pi R_j} \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(r^{(i)} - R_j)^2}{2\sigma^2}}$$

  - Poisson distribution

$$P(\text{m photons}) = \frac{e^{-p_j} p_j^m}{m!}$$

    where $p_j = s_j + b$, s_j and b are the expected number of signal and background photons respectively in surface A
  - Likelihood function for hypothesis j

$$L_j = P(m) \times \prod_{i=1}^{m} \left(\frac{S_j(\vec{x}^{(i)}) + B(\vec{x}^{(i)})}{s_j + b} \right)$$